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[Claim(s)]

[Claim 1]It is provided in the inner surface of a substrate and the; above-mentioned substrate with the inner surface which is formed by a part of surface of a sphere at least, and is continuing in a circle, It has an elastic-surfaces wave generating means and; which generate an elastic-surfaces wave which goes in the direction in which the inner surface of the above-mentioned substrate continues, A spherical surface acoustic device to which an elastic-surfaces wave generating means is characterized by what an elastic-surfaces wave is generated for so that it may go in the direction in which the inner surface of the above-mentioned substrate continues without being spread in the above-mentioned continuous direction and the crossing direction along the surface in the above.

[Claim 2]A spherical surface acoustic device given in Claim 1 which the above-mentioned substrate is formed with non-piezo-electricity material, the above-mentioned elastic-surfaces wave generating means is provided in the inner surface of the above-mentioned substrate, and it has a piezo-electric material film, and is characterized by generating an elastic-surfaces wave in the direction which carries out the seal of approval of the electric field to a piezo-electric material film, and in which the inner surface of the above-mentioned substrate continues.

[Claim 3]A spherical surface acoustic device given in Claim 1 which forming the above-mentioned substrate with a piezo-electric material, and forming so that an elastic-surfaces wave may be generated in the direction which the above-mentioned elastic-surfaces wave generating means is provided in the inner surface of the above-mentioned substrate, and carries out the seal of approval of the electric field to a substrate, and in which the inner surface of the above-mentioned substrate continues.

[Claim 4]A spherical surface acoustic device given in Claim 2 or Claim 3 characterized by what a means which carries out the seal of approval of the above-mentioned electric field contains the Kushigata electrode connected to a high frequency power supply for.

[Claim 5]A spherical surface acoustic device given in Claim 4, wherein a wavelength of an elastic-surfaces wave which the Kushigata electrode generates is 1/10 or less [of a radius of the above-mentioned surface of a sphere].

[Claim 6]A spherical surface acoustic device given in Claim 4 or Claim 5 characterized by what overlap width of an electrode in a direction which intersects perpendicularly in the propagation direction of an elastic-surfaces wave which a comb type electrode generates is 1/100 or more [of the above-mentioned radius] below in half of a diameter of the above-mentioned surface of a sphere.

[Claim 7]A spherical surface acoustic device of Claim 1 characterized by having a laser beam absorption

layer which generates elastic vibration on the surface of inner which absorbs the above-mentioned laser beam in part, and contains an elastic-surfaces wave as an elastic-surfaces wave generating means at least while the above-mentioned substrate comprises material which penetrates a laser beam.
[Claim 8]A spherical surface acoustic device given [Claim 1 to which an inside of the above-mentioned substrate is characterized by enclosing whether a vacuum, specific gas, or a fluid is filled to] in 7 any 1 paragraphs.
[Claim 9]A spherical surface acoustic device given [Claim 1, wherein the above-mentioned substrate has an opening aiming at flowing/flowing fluid out of / in an inside of a substrate at both two surface-of-a-sphere both / one side or / separated by field which an elastic-surfaces wave spreads in a circle to] in 8 any 1 paragraphs.
[Claim 10]A spherical surface acoustic device given [Claim 1, wherein a layer which consists of a reactant material from which it reacts to gas and a fluid which flow from the outside, and elastic character changes to the inside side of the above-mentioned substrate is formed to] in 9 any 1 paragraphs.

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention is related to a surface acoustic device, and related to the spherical surface acoustic device which provided the elastic-surfaces wave generating means in the surface in the above of the substrate with the inner surface which is formed in a part of surface-of-a-sphere shape at least, and is continuing in a circle in detail.
[0002]
[Description of the Prior Art]While generating an elastic-surfaces wave on a substrate, the surface acoustic device is well known from the former as what receives the elastic-surfaces wave generated on the substrate. In the conventional surface acoustic device, one pair of Kushigata electrodes are provided on the piezo-electric body, By supplying high frequency voltage to one Kushigata electrode, it is arranged in the move direction of an elastic-surfaces wave which generates an elastic-surfaces wave in the direction in which one Kushigata electrode is located in a line and in which the Kushigata electrode of another side is generated from one Kushigata electrode, and the above-mentioned elastic-surfaces wave is received. The surface acoustic device is used for a filter, a chemical sensor, a biosensor, or a remote tag for choosing the oscillation element for a delay line and a transmitter and a resonance element, and frequency, etc.
[0003]
[Problem to be solved by the invention]And in order to raise the accuracy of resonance frequency in a surface acoustic device, to make the propagation loss at the time of an elastic-surfaces wave spreading between [one pair of] Kushigata electrodes as small as possible is desired.
[0004]However, the surface of the piezo-electric body and the surface of a substrate in which, as for the usual surface acoustic device, one pair of Kushigata electrodes are provided will diffuse the elastic-surfaces wave generated from one Kushigata electrode since it was flat also in the direction which intersects perpendicularly with the propagation direction on the above-mentioned surface while spreading toward the Kushigata electrode of another side, and it will become weaker. For this reason, being unable to make the propagation loss of an elastic-surfaces wave small, but improving the

performance in a surface acoustic device by extension has a limit. Although it is compact and the surface acoustic device excellent in the electric target can also be constituted by using a comb type electrode for the surface outside a spherical substrate, In order that the field which an elastic-surfaces wave spreads may be outside exposed, the portion which is not allowed contact exists and there is difficulty without the sufficient space securable on the surface of a ball for adding electric parts required to perform handling, and fixation and still more nearly electric processing to it. Even though it uses as a sensor of gas or a fluid, it must insert into the course into which these fluid flows, and it becomes difficult when only a little fluid to be observed can be especially prepared among small piping.

[0005]Under such a situation, this invention is made and, [SUBJECT of this invention] It is easy to have composition which provides a compact spherical surface acoustic device, and it not only can improve performance far, but cannot be easily affected by influence of external atmosphere compared with the conventional surface acoustic device, Fixation is easy and is being able to constitute the sensor treating fluid easily and providing further, the surface acoustic device which can be added easily for electric parts still more nearly required for input and output etc.

[0006]

[Means for solving problem]This invention solves this SUBJECT and, [the invention of Claim 1] A substrate with the inner surface which is formed by a part of surface of a sphere at least, and is continuing in a circle, The elastic-surfaces wave generating means which generates the elastic-surfaces wave which goes in the direction in which it is provided in the inner surface of the above-mentioned substrate, and the inner surface of the above-mentioned substrate continues, Let what an elastic-surfaces wave is generated for so that it may go in the direction in which the inner surface of the above-mentioned substrate continues without spreading preparation ****** and an elastic-surfaces wave generating means along the surface in the above in the above-mentioned continuous direction and the crossing direction be a spherical surface acoustic device by which it is characterized.

[0007]With non-piezo-electricity material, the above-mentioned substrate is formed by the invention of Claim 2 of this invention, and, [the above-mentioned elastic-surfaces wave generating means] It is provided in the inner surface of the above-mentioned substrate, and it has a piezo-electric material film, and is considered as the spherical surface acoustic device of a description at Claim 1 generating an elastic-surfaces wave in the direction which carries out the seal of approval of the electric field to a piezo-electric material film, and in which the inner surface of the above-mentioned substrate continues.

[0008]With a piezo-electric material, the above-mentioned substrate is formed by the invention of Claim 3 of this invention, and, [the above-mentioned elastic-surfaces wave generating means] It is provided in the inner surface of the above-mentioned substrate, and is considered as the spherical surface acoustic device of a description at Claim 1 currently forming so that an elastic-surfaces wave may be generated in the direction which carries out the seal of approval of the electric field to a substrate, and in which the inner surface of the above-mentioned substrate continues.

[0009]Let a means by which the invention of Claim 4 of this invention carries out the seal of approval of the above-mentioned electric field be a spherical surface acoustic device of a description at Claim 2 or Claim 3 characterized by what the Kushigata electrode connected to a high frequency power supply is included for.

[0010]Let the wavelength of the elastic-surfaces wave on which the Kushigata electrode generates the invention of Claim 5 of this invention be a spherical surface acoustic device of a description at Claim 4 being 1/10 or less [of the radius of the above-mentioned surface of a sphere].

[0011]Let overlap width of the electrode in the direction in which the invention of Claim 6 of this invention intersects perpendicularly in the propagation direction of the elastic-surfaces wave which a comb type electrode generates be a spherical surface acoustic device of a description at Claim 4 or Claim 5 characterized by what is been 1/100 or more [of the above-mentioned radius] below in half of the diameter of the above-mentioned surface of a sphere.
[0012]While the invention of Claim 7 of this invention comprises material which penetrates a laser beam, [an invention] [the above-mentioned substrate] It is considered as the spherical surface acoustic device of Claim 1 having a laser beam absorption layer which generates elastic vibration of the inner surface which absorbs the above-mentioned laser beam and contains an elastic-surfaces wave in part at least as an elastic-surfaces wave generating means.
[0013]The invention of Claim 8 of this invention uses the inside of the above-mentioned substrate as a surface acoustic device given in 7 any 1 paragraphs from Claim 1 enclosing [whether a vacuum, specific gas, or a fluid is filled and].
[0014]In two surface-of-a-sphere fields separated by the field which an elastic-surfaces wave spreads in a circle, on the other hand, the invention of Claim 9 of this invention the above-mentioned substrate, [or both] It is considered as a surface acoustic device given in 8 any 1 paragraphs from Claim 1 having an opening aiming at flowing/flowing fluid out of / in the inside of a substrate.
[0015]The invention of Claim 10 of this invention reacts to gas and the fluid which flow into the inside side of the above-mentioned substrate from the outside, and is taken as a surface acoustic device given in 9 any 1 paragraphs from Claim 1, wherein the layer which consists of a reactant material from which elastic character changes is formed.
[0016]In order to attain SUBJECT mentioned above, [the spherical surface acoustic device according to this invention] A substrate with the inner surface which is formed in a part of surface-of-a-sphere shape at least, and is continuing in a circle, The elastic-surfaces wave generating means which generates the elastic-surfaces wave which goes in the direction in which it is provided in the inner surface of the above-mentioned substrate, and the inner surface of the above-mentioned substrate continues, It is characterized by what an elastic-surfaces wave is generated for so that it may go in the above-mentioned continuous direction, without spreading preparation ****** and an elastic-surfaces wave generating means along the surface in the above in the above-mentioned continuous direction and the crossing direction. For this reason, an elastic-surfaces wave can be spread without diffusing the circumference distance of the surface in the above at least along the surface in the above, and can be spread infinitely by extension.
[0017]Therefore, since it has the inner surface which performance can be far improved compared with the conventional surface acoustic device, and the substrate is formed by a part of surface of a sphere at least, and is continuing in a circle, it is also compact.
[0018]With non-piezo-electricity material, the above-mentioned substrate is formed and, [the above-mentioned elastic-surfaces wave generating means] It is provided in the inner surface of the above-mentioned substrate, and has a piezo-electric material film, and an elastic-surfaces wave can be excited efficiently and a powerful element can consist of that it is characterized by generating an elastic-surfaces wave in the direction which carries out the seal of approval of the electric field to a piezo-electric material film and in which the inner surface of the above-mentioned substrate continues.
[0019]Also when the above-mentioned substrate is formed with a piezo-electric material, [the above-mentioned elastic-surfaces wave generating means] An elastic-surfaces wave can be excited efficiently

and a powerful element can consist of easily that it is characterized by generating an elastic-surfaces wave in the direction which is established in the inner surface of the above-mentioned substrate, and carries out the seal of approval of the electric field to a substrate and in which the inner surface of the above-mentioned substrate continues.

[0020]Here, since the means which carries out the seal of approval of the above-mentioned electric field is characterized by including the Kushigata electrode connected to a high frequency power supply, it is still higher efficiency and it can excite an elastic-surfaces wave in the specific direction, and it can constitute the still more powerful element as a result.

[0021]Vibration can consider that the wavelength of the elastic-surfaces wave which the Kushigata electrode generates is an elastic-surfaces wave with not characteristic vibration but the wavelength of the whole ball equal to an electrode cycle by being characterized by being 1/10 or less [of the radius of the above-mentioned surface of a sphere].

[0022]The full width of surface structures, such as a comb type electrode and an attendant electric circuit pattern, needs to be below half of the circumference length of a ball, therefore, as for the rational width of the overlap portion of a comb type electrode, below half of a diameter becomes. On the other hand, since a surface wave is diffused greatly and it becomes impossible to disregard vibration on the whole ball surface with propagation when the overlap width of the electrode of a comb type electrode becomes 1/100 or less [of a radius], it becomes difficult to install an electrode circuit pattern, a structure-preserving object, etc. in the inner surface of a surface of a sphere. It becomes difficult to make the opening for carrying out inflow discharge of gas or the fluid at the substrate inside at the time of constituting a sensor etc. without affecting propagation of an elastic-surfaces wave.

[0023]While comprising material which penetrates a laser beam, [a substrate] [the spherical surface acoustic device which has a laser beam absorption layer which excites elastic vibration of the inner surface which absorbs the above-mentioned laser beam in part at least, and contains an elastic-surfaces wave as an elastic-surfaces wave generating means] An elastic-surfaces wave can be generated and detected, without constituting a piezo-electric material and an electrode pattern inside a substrate, and it has an advantage which can be used even if it passes or encloses the high fluid and gas of activity with which a piezo-electric material is corroded by the substrate inside.

[0024]The inside of the above-mentioned substrate can give the advantage which can suppress intentionally the influence of change of external atmosphere which will make humidity etc. the start if it encloses whether a vacuum, specific gas, or a fluid is filled.

[0025]The above-mentioned substrate is having an opening aiming at flowing/flowing fluid out of / in the inside of a substrate at both two surface-of-a-sphere both [one side or] separated by the field which an elastic-surfaces wave spreads in a circle, Existence of fluid can constitute a fluid detection sensor etc. only from connecting fluid to be analyzed to those openings easily via affecting the propagation situation of the elastic-surfaces wave which spreads the inside of a substrate.

[0026]It reacts to gas and the fluid which are inserted in the inside side of the above-mentioned substrate from the outside, and if the layer which consists of a reactant material from which elastic character changes is constituted, also when only very little fluid to be analyzed can be prepared especially, it has an advantage which a quantity required to fill the spherical inside of a substrate should just have.

[0027]

[Mode for carrying out the invention]It explains in detail, referring to drawing 1 in attached Drawings for the spherical surface acoustic device which followed a 1st embodiment of this invention below.

Drawing 1 (a) is the explanatory view which expressed the first example of an embodiment of the spherical surface acoustic device of this invention with eye squinting, and drawing 1 (b) is the explanatory view which expressed the elastic-surfaces wave generating means concerning this example of a form with the plane.
[0028]The spherical surface acoustic device 1 according to a 1st embodiment is provided with the substrate 2 with the spherical inner surface 2c, and the elastic-surfaces wave generating means 4 installed in the position of the request on the inner surface 2c of the substrate 2. The elastic-surfaces wave generating means 4 generates the elastic-surfaces wave which moves as the arrow A shows along the maximum circumference line 2a by which the inner surface 2c of the substrate 2 which passes through an own installed position tends to continue. [the above-mentioned elastic-surfaces wave which the elastic-surfaces wave generating means 4 generates] It moves in the inside of the ring field 2b which comprises a part of surface of a sphere at least along the maximum circumference line 2a in the inner surface 2c of the substrate 2, and is continuing in a circle, and is not spread outside the ring field 2b in the direction which crosses to the maximum circumference line 2a by which the surface 2c in the above tends to continue along the surface 2c in the above.
[0029]If it explains in detail, the substrate 2 which has a spherical inside 12.5 mm in diameter, for example is formed more, without non-piezo-electricity material, for example, ceramics. In this embodiment provided with the oscillating means 4b which the elastic-surfaces wave generating means 4 is formed in the piezo-electric material film 4a stuck on the position of the above-mentioned request on the inner surface 2c of the substrate 2, and the piezo-electric material film 4a upper and lower sides, and vibrates in the above-mentioned continuous direction, The oscillating means 4b is provided with the Kushigata electrodes 4c (top electrode) and 4d (lower electrode) connected to the high frequency power supply 6. Two or more Kushigata electrodes [4c and 4d] pieces of an electrode are arranged in the above-mentioned continuous direction, the overlap width W of the electrode is 2 mm, and the electrode cycle P is 350 microns, and the two poles of the high frequency power supply 6 are connected from the outside of the ring field 2b in the direction which crosses to the maximum circumference line 2a.
[0030]The spherical surface acoustic device 1 is supported by the upper part from on the substrate 9 with one pair of base materials 8 fixed to the surface outside the spherical substrate 2 from the outside of the ring field 2b in a direction which crosses to the maximum circumference line 2a.
[0031]A wavelength of an elastic-surfaces wave generated from the elastic-surfaces wave generating means 4 is 350 microns, It is set or less [of a radius on the surface 2c of inner of the substrate 2 with a globular form-like inside] to 1/10, and is set or less [of a radius on the surface of inner of the substrate 2 in which distance of two or more electrode cycles P of the Kushigata electrode 4c also has a globular form-like inside at 350 microns for this reason] to 1/10. Along the surface 2c in the above, width of the above-mentioned elastic-surfaces wave in the above-mentioned continuous direction and a crossing direction is a little less than 3 mm, and is set up to become 1/100 or more [of the above-mentioned radius] at 12.5 mm or less (preferably below half of this diameter) in diameter of the substrate 2 of a spherical inside. For this reason, Kushigata electrodes [4c and 4d] overlap width is set up to become 1/100 or more [of the above-mentioned radius] below for a diameter (preferably below half of this diameter) of the spherical substrate 2.
[0032][this invention] When an inventor of an application concerned, etc. generate an elastic-surfaces wave in the direction which intersects perpendicularly with the above-mentioned circle in a material inside with surface-of-a-sphere shape with a circle (linear sound source width on the globular form-like

inner surface) of a predetermined range. It was made by having discovered going the above-mentioned spherical inside around in the direction which intersects perpendicularly with the above-mentioned circle, without spreading an elastic-surfaces wave in the direction of the above-mentioned circle along a direction which intersects perpendicularly with the above-mentioned circle.
[0033][the source (sound source) of an elastic-surfaces wave smaller than the above-mentioned predetermined range] If the source of an elastic-surfaces wave is made into a point in order to simplify the talk, an elastic-surfaces wave will converge on concentric circular toward the point of the side with the opposite above-mentioned source, after spreading the inner surface top of the substrate which has a globular form-like inside focusing on a source in concentric circular, After spreading the inner surface top of a spherical substrate in concentric circular from the near point of the above-mentioned positive contrary, it converges on the source of the elastic-surfaces wave located as opposed to the near point of the above-mentioned positive contrary in the inner surface of a spherical substrate again. Namely. [the source of an elastic-surfaces wave smaller than the above-mentioned predetermined range] The elastic-surfaces wave emitted from the source of the elastic-surfaces wave will be diffused in the direction which intersects perpendicularly with the direction of movement in the surface in the above, and will affect propagation of an elastic-surfaces wave by formation of electrode extraction and the opening for carrying out ON discharge of the fluid inside.
[0034]In the source of a wide elastic-surfaces wave, the elastic-surfaces wave generated from the source converges the circumference line which contains the above-mentioned circle while moving along the direction which passes through the center of the above-mentioned predetermined range, and intersects perpendicularly with the circle of the above-mentioned predetermined range toward the position applicable to the equator and the pole at the time of ********, After passing through the position applicable to a pole, on the above-mentioned circumference line, it is spread in the opposite side of the above-mentioned predetermined range at the above-mentioned predetermined range and the same predetermined range, It converged toward the position applicable to another pole, and after passing through the position applicable to another pole, convergence and diffusion are repeated for every semicircle of a ball [say / being again spread in the above-mentioned predetermined range].When converging on a point, and amplitude becomes large too much locally, it is [be / although / it is infinitely repeatable theoretically also in this case,] possible that the alignment effect arises and unexpected influence appears in an output. Even when other, the problem of the attachment place of the ON discharge paragraph of an electrode extraction mouth or fluid being unable to secure in an inside arises.
[0035]The conditions for the phenomenon which goes the above-mentioned surface of a sphere around in the direction which intersects perpendicularly with the above-mentioned circle were searched for as follows, without spreading an elastic-surfaces wave in the direction of the above-mentioned circle. Although an explanatory view assumes the ball surface and is performed here, the case on the surface of outside is also completely the same also for the case on the surface of inner.
[0036]The coordinate system for the calculation which shows the effect of this invention is shown in drawing 2. Suppose the intersection of the surface of a sphere of a xyz axis of coordinates and the radius r that the elastic-surfaces wave generated from the point P on the parallel circle DF to the circle AC as A, B, and C reaches the point Q on the circle CG. If angle phi_o, $theta_o$, phi_1, and $theta_1$ are taken as shown in drawing 2, Since the coordinates of the points P and Q become ($rcosphi_o costheta_o$, $rsinphi_o$,

$r\cos\phi_o\sin\theta_o$), and ($r\cos\phi_1\cos\theta_1$, $r\cos\theta_1\sin\phi_1$, $r\sin\theta_1$), $PQ^2=2r^2$ [1-$\cos\phi_o\cos\theta_o\cos\phi_1\cos\theta_1$-$\sin\phi_o\cos\phi_1\cos\theta_1$-$\cos\phi_o\sin\phi_o\sin\theta_1$] -- It is (1). Therefore, when it sets with angle POQ=theta, it is $\cos\theta=\cos\phi_o\cos\theta_o\cos\phi_1\cos\theta_1+\sin\phi_o\cos\phi_1\cos\theta_1+\cos\phi_o\sin\phi_o\sin\theta_1$ from a **** theorem. -- The relation of (2) is realized.

[0037]A radial ingredient of particle displacement in the point Q of an elastic-surfaces wave generated at the point P,[0038]

[Mathematical formula 1]

$$u_r=R_e\left(\frac{C}{\sqrt{\sin\theta}}\exp\left\{im\left(\theta-\frac{C_R t}{r}\right)\right\}\right)$$

-- (3)

[0039]Come out and it is (Viktorov, Rayleigh and Lamb Waves). Here, C is a constant, m is a ratio of the length of the circumference, and a wavelength of an elastic-surfaces wave, and it is called a wave number parameter. C_R is Rayleigh wave speed and t is time. The angle theta is called for from a formula (2). An acoustic field of the point Q according [an angle seen and crowded from the point E] to a circular sound source of $2\theta_A$ is about θ_o about a formula (3). - It is obtained by finding the integral from θ_A to θ_A. Acoustic field distribution is called for by calculating by changing **** θ_1 of the point Q.

[0040]Four states where an elastic-surfaces wave for which it asked using the above-mentioned formula (3) about (a) of drawing 3, (b), (c), and a case of $\phi_o=0$ which has the point P on XZ side at (d) spreads the spherical substrate 12 top are shown.

[0041](a) of drawing 3, (b), and (c) are the results of investigating the acoustic field (angle θ_1 dependence of the absolute value of particle displacement) in the case of the wave number parameter m= 600. In each of a figure, the bottom plot is an acoustic field in case angle (propagation angle) ϕ_1 showing propagation of the elastic-surfaces wave on a surface of a sphere is 10 degrees, and the acoustic field at the time of increasing 20 degrees at a time toward a top is plotted in order.

[0042](a) of drawing 3 is a case of opening half width θ_A=30 degree. In this case, the propagation state of an elastic-surfaces wave is converging beam shape so that clearly from (a) of drawing 3. That is, after the width of an acoustic field decreasing and becoming the minimum at ϕ_1=90 degree as propagation angle ϕ_1 increases, width increases again and the same distribution as a sound source top is reproduced at 180 degrees of opposite-poles points. henceforth -- every 180 degrees -- the above -- the

same change winds and changes and is carried out, and the same change winds and changes and is made what round time. This is a phenomenon peculiar to a surface of a sphere without diffusion of the wave by diffraction. In this case, an acoustic field does not spread rather than opening half width θ_A=30 degree, and the energy of the elastic-surfaces wave is shut up by the band-like portion of $\theta_1<\theta_A$. In this case, even if it contacts other objects into the portion of $\theta_1>\theta_A$ in the surface outside the spherical substrate 12, turbulence is not produced in an acoustic field.
[0043](c) of drawing 3 is a case of opening half width θ_A=1 degree. In this case, the propagation states of an elastic-surfaces wave are a case of a simple point sound source, and similar emission beam shape so that clearly from (c) of drawing 3. That is, after the width of an acoustic field also increasing and becoming the maximum at ϕ_1=90 degree as propagation angle ϕ_1 increases, width decreases again and the same distribution as a sound source top is reproduced at 180 degrees of opposite-poles points. In this case, unlike a case, the energy of an elastic-surfaces wave is not confined in the converging beam mentioned above while referring to (a) of drawing 3 by the band-like portion of $\theta_1<\theta_A$, and it will spread in a whole abbreviated large circle at ϕ_1=90 degree. In this case, if other objects are contacted into the portion of surface $\theta_1>\theta_A$ outside the spherical substrate 12 in ϕ_1=90 degree in the surface outside the spherical substrate 12, turbulence will arise in an acoustic field.
[0044](b) of drawing 3 is a case of opening half width θ_A=3.5 degree. In this case, even if propagation angle ϕ_1 increases the propagation state of an elastic-surfaces wave so that clearly from (b) of drawing 3, the width of an acoustic field is the collimation beam shape where it hardly changes. That is, the energy of the elastic-surfaces wave is shut up by the band-like portion of $\theta_1=\theta_A$. This is the same characteristic as the BESSERU beam in an infinite medium. And opening half width θ_A from which a collimation beam is obtained is called collimation angle θ_{col}.
[0045]it is ****** from (a) of drawing 3 thru/or (c) -- like -- opening half width θ_A -- collimation angle θ_{col} -- abbreviation -- when equal, the energy of the elastic-surfaces wave is shut up by the band-like portion with the narrowest width.
[0046]As a result of conducting numerical analysis same with having changed the wave number parameter and having mentioned above, it turned out that collimation angle θ_{col} changes with wave number parameters m. As for (d) of drawing 3, that the propagation state of an elastic-surfaces wave becomes collimation beam shape when the wave number parameter m is 300 will show that opening half width θ_A is abbreviated 4.5 degree, and collimation angle θ_{col} in this case will be abbreviated 4.5 degree.
[0047]Below, the value of collimation angle θ_{col} when the wave number parameter m changes is shown.
[0048]

Wave number parameter m Collimation angle $theta_{col}$ (the circumference length / elastic-surfaces wave wavelength of a ball)
150 7.0 300 4.5 450 4.0 600 3.5 750 3.0, in addition this are the approximate values by numerical computation.
[0049]He is trying to ask for collimation angle $theta_{col}$ from the wave number parameter m by this embodiment like [it is ****** from having explained in full detail above, and] using the above-mentioned formula (3). and the position of the request on the inner surface of the having-spherical inside substrate 2 -- the elastic-surfaces wave generating means 4 -- more -- detailed -- the Kushigata electrode 4c of the oscillating means 4b of the elastic-surfaces wave generating means 4. If it is installed more widely than the width specified by ** collimation angle $theta_{col}$ and an elastic-surfaces wave is generated by this elastic-surfaces wave generating means 4, This elastic-surfaces wave is spread without diffusing within the limits specified with the overlap width of the electrode on the inner surface of the having-spherical inside substrate 2 in the direction of above-mentioned collimation angle $theta_{col}$. In drawing 1, the direction which the mentioned range specified with the overlap width of the electrode is equivalent to the ring field 2b, and intersects perpendicularly with above-mentioned collimation angle $theta_{col}$ corresponds in the direction which met the maximum circumference line 2a.

[0050]And in fact, wavelength parameters (the circumference length / elastic-surfaces wave wavelength in the above-mentioned continuous direction of the above-mentioned surface of a sphere) are 100 thru/or 800, and the width of the electrode of the Kushigata electrode is equal to a collimation angle (angle from which a collimation beam is obtained), or what is been more than it is preferred.
[0051]Here, the wavelength of the elastic-surfaces wave to generate is generally, the cycle length, i.e., the electrode cycle, of electric field distribution which are produced in a piezo-electric material by the seal of approval of the electric field being carried out to a comb type electrode, equal. Also when an electrode spacing has plurality or the continuous width so that the surface acoustic device for broadbands may see, the case where the above-mentioned conditions are realized about the wavelength of each frequency component of the elastic-surfaces wave equivalent to it -- the frequency component -- the propagation direction -- the surface acoustic device which an elastic-surfaces wave does not diffuse perpendicularly can be constituted.
[0052]Drawing 4 is an explanatory view showing other examples of an embodiment. An embodiment when a fluid sensor is constituted is shown using the spherical surface acoustic device of this invention. As shown in drawing 4 (a), a ********** section manufactures the glass thick boards 20 (8-mm thickness) so that the radius R may serve as a part with a ball inside shape of 6.25 mm (12.5 mm in diameter). ************ and the circular hole open to the upper and lower sides of the thick board are used as the openings 30 and 31, such as fluid. Next, the elastic-surfaces wave generating means shown by drawing 1 (b) is created. Drawing 4 (b) is an explanatory view showing typically how to form a top electrode and a lower electrode by resistance heating vapor deposition. The deposition material 22 (electrode material) is heated with the vapor deposition heater 23, and it vapor-deposits to an object. As shown in drawing 4 (b) at the section of the glass thick boards 20 part, using the vapor deposition mask 21 (the shape seen from the transverse direction is illustrated typically) in which the electrode pattern was formed, heating vapor deposition of the electrode material is carried out, and the lower electrode 24 of chromium membrane (500A) and gold (1500A) is formed. The electrode cycle P was designed by

using 100 micrometers be easy to excite a 40-MHz Rayleigh wave (sonic 4000 m/s). The overlap width W of an electrode is 2 mm, and fulfills the conditions of the point for going around to band-like. Drawing 4 (c) is an explanatory view showing typically how to form the thin film of a piezo-electric material by DC sputtering. As shown in drawing 4 (c), the thick board 20 in which the lower electrode 24 was formed in the chamber 25, the target 26 of ZnO, the electrode for sputterings, etc. are installed, Oxygen gas is introduced in a chamber, from DC high-pressure power supply 27, DC voltage is applied to the target 26 of ZnO, and the inter-electrode one for sputterings, and a ZnO film (20 micrometers in thickness) is formed in them. While arranging the target made from ZnO to 30 or about 31 opening at this time, the electrode which counters is installing in the opposite side, and can grow up the piezoelectric film of ZnO into a substrate inside. Next, a top electrode is vapor-deposited like a lower electrode, and is formed. The concentration of the gas used by a sputtering, the voltage of DC high-pressure voltage, etc. can use a publicly known method also about the preparation method of a vapor deposition mask.

[0053]Then, as an electrode was taken out from two places outside and the back was shown in drawing 4 (d), fluid piping was connected on both sides of the ******** part of a glass thickness board, and the fluid sensing sensor 40 was created. The composition of the comb type electrode which the comb type electrode adopted is the same as a 1st embodiment. A circuit as shown in drawing 5 (a) to the created fluid perception sensor 40 is constituted, and input and output of the signal to the fluid perception sensor 40 can be performed. By a diagram, a pulse signal is generated by the impulse signal generator 44, and a pulse signal is inputted into the fluid perception sensor 40 via the circulator 41. The signal generated from the fluid perception sensor 40 is outputted to the oscilloscope 43 via the amplifier 42 from the circulator 41, and is displayed as a signal waveform. When the seal of approval of the pulse signal (200V) of the short-time width of drawing 4 (b) was carried out to the fluid perception sensor 40, the elastic-surfaces wave generated with the comb type electrode was observed as a signal which carries out the propagation circumference of the ball inside-shaped section, and shows the reflective wave again to a comb type electrode as an output from self at drawing 4 (c). In order to observe only a Rayleigh wave ingredient (frequency of about 40 MHz), it is displaying except for a not less than 50-MHz frequency component. Especially the time between in [A and B] a figure was 11.5 microseconds in the state where a fluid is not flowing into fluid piping.

[0054]Next, when a fluid flowed through an inside, the intensity checked that it was detectable that the fluid flowed by it becoming impossible almost checking weakly.

[0055]If they and the material from which an elastic usual state number changes in response to the part at least of the ring field by the side of an inside are applied so that it may be touched although the sensor of gas and the fluid which are led to a substrate inside is constituted, Since propagation of the elastic-surfaces wave which spreads a substrate inside as a result is affected, the sensor based on the chemical nature of fluid, such as a bad smell, can be constituted, and the quantity of the then required gas for [analyzing] or a fluid is an advantage also with extraordinary also ending in the minimum quantity required to fill the inside of a substrate. DIGU which changes elastic character with gas -- a lycee -- although there are a roll, methyl silicone, etc., since it is publicly known about change of the elastic character by applying such materials to the surface, it does not explain here, and this invention is not restricted by these kinds.

[0056]Thus, since the spherical surface acoustic device according to this invention has a ring field

spread by the elastic-surfaces wave in the inside of a substrate, fixation of an element is not only easy, but, [fixation] It is also possible to install the amplifying device for signal processing, etc. in the external surface of a substrate, if the whole is enclosed with a conductor, it is strong by the electric noise from the outside, and it is also easy to prevent revealing an internal signal outside and affecting other devices. When using it as a frequency filter especially, if fluid is not passed inside, it is [like] possible to achieve miniaturization more by the thing which do not touch the inner surface which an internal elastic-surfaces wave spreads and for which other element and parts are stored in an inside so that there may be nothing.

[0057]In the embodiment and modification which were mentioned above, the spherical surface acoustic device 1 is formed by establishing the oscillating means 4b on the piezo-electric material film 4a provided in the predetermined position on the surface of inner of the substrate 2 with a spherical inside of a non-piezo-electricity object. However, the substrate 2 can also be formed by a piezo-electric material, and as shown in drawing 6 (a), the surface elastic wave generating means 52 (double electrode) can be directly established in a predetermined position on the inner surface 51 of the substrate 50 formed of a piezo-electric material. In this case, for example, it is PZT, and the substrate 50 should just form the electrode pattern directly shown in drawing 6 (b) by vapor deposition with chromium and gold, and is very easy to create.

[0058]Although formed by the detailed pattern about the electrode pattern shown in drawing 6 (b), unlike the time of forming on both sides of a piezo-electric object with an electrode, position ****** was easy, and it was possible to also have formed such a complicated electrode pattern in an inside. This cycle of the wavelength of the ultrasonic wave which is 350 microns and is generated is also the same, and is 350-micron ******.

[0059]In using it for a frequency filter etc., the inside of a substrate A vacuum. Or if it fills with specific gas and fluid and an opening is closed, when propagation of the elastic-surfaces wave of the inside by the humidity of the open air or change of atmosphere receives influence, it is easily possible to prevent the output characteristic of an element changing.

[0060]It can prepare by all the means which there is no restriction in the diameter on the surface of inner of the substrate which is used in the spherical surface acoustic device of this invention, and which is formed by a part of surface of a sphere at least, and is continuing in a circle, and can be known from the thing of a very big diameter to the thing of a very small diameter now.

[0061]The piezo-electric material film provided in the predetermined position on the surface of inner of the above-mentioned substrate can also be prepared by all the means which can be known now, and can be prepared by all the means which can also know now the oscillating means provided in the predetermined position on this piezo-electric material film top or the surface of inner of the above-mentioned substrate. It includes sticking on the predetermined position on a piezo-electric material film top or the surface of inner of the above-mentioned substrate what was formed independently in the shape of a Kushigata electrode from conductive foil, or forming it by vapor deposition, printing, sputtering, etc. on a piezo-electric material film or the inner surface of the above-mentioned substrate in all the means which can be known now in here.

[0062]In order to distinguish a fluid from an elastic-surfaces wave in case there is no fluid intentionally about a ****** case inside, although an elastic-surfaces wave when the fluid has touched may be called a disclosure elastic-surfaces wave, by this invention, this disclosure elastic-surfaces wave is also called the elastic-surfaces wave, and a disclosure elastic-surfaces wave is not excepted.

[0063]The mode called the corridor wave spread along the surface in a substrate also exists, centralizing energy on the fluid side a substrate inside and near the fluid boundary, since it is equal to the acoustic velocity of a fluid, can carry out like as a sonic measurement sensor of a fluid, but. This invention is not excepted also when propagation of the wave called these corridor wave is made applicable to perception.
[0064]The embodiment of others of this invention is described using drawing 7 below. According to this 2nd embodiment, the methods of exciting and detecting an elastic wave and an elastic-surfaces wave differ. Although the elastic-surfaces wave can make it generate by applying an electric field to a piezo-electric material which was explained in full detail above, it can generate and output a disclosure elastic wave also by irradiating material with a laser beam and causing thermal expansion.
[0065]As how to apply a laser beam, it is moving a straight line-shaped irradiation region to the material (substrate) surface, and a straight line can be made to carry out the excitation propagation of the elastic wave perpendicularly. Interference fringes can be formed by making two laser beams interfere on a material list side, and an elastic-surfaces wave can be efficiently generated especially by it. Methods of generating an elastic-surfaces wave efficiently include the method of using scanning interference fringes (SIF). Since the method of exciting an elastic-surfaces wave using these laser beams is publicly known, it does not explain in detail here, but explanation is added [method / using SIF] about the embodiment.
[0066]A substrate including a spherical circular inside is created with clear glass. Outside the substrate, since the surface was easy to fix, it was processed into the rectangular parallelepiped, and it performed optical polish smoothly to laser about the 2nd page. About the clear glass inside, aluminum vapor deposition is performed on the whole surface. The minimum thickness required to absorb and reflect a laser beam may be sufficient as aluminum vapor deposition.
[0067]As for the laser beam by which new was carried out from the laser oscillator, it is divided with the optical component called a beam splitter to two beams, and, on the other hand, is accepted, and only deltaf is a frog about frequency. The scanning interference fringes by a laser beam can be formed, an aluminum side can cause thermal expansion by distribution of the same interference fringes, an elastic wave, especially a surface elastic wave can be oscillated efficiently, and an elastic-surfaces wave can be made to spread on an inside by making these beams interfere on the aluminum side of a substrate inside.
[0068]The explanatory view showing roughly the whole device with which drawing 7 (a) is used for elastic-surfaces wave generating on the surface in a substrate of the example of other embodiments, and drawing 7 (b) are the explanatory views which expressed the surface acoustic wave device of this example of an embodiment with the section. (a) of drawing 7 generates an elastic-surfaces wave on the surface 12 in a substrate of the spherical substrate 10, and shows the device for detecting it. The two YAG laser beams L1 3 mm in diameter and L2 are turned to the abbreviated right angle to the predetermined range W on the surface 12 of inner of the substrate 10 ((b) of drawing 7), As for the YAG laser beam L2 of another side, 30 MHz of frequency is deviated to one YAG laser beam L1 using 14 g of BURAGUSERU. Scanning interference fringes are formed in the portion with which the two laser beams L1 and L2 were irradiated by interference of two laser beam [accompanied by different frequency] L1, and L2 in the predetermined range W on the surface of inner of the substrate 10 (drawing 7 (b)).
[0069]While the average crevice between interference fringes is made equal to the wavelength of an elastic-surfaces wave, with a mechanical adjustment device like the 1st subrotation reflector 14d, the 2nd subrotation reflector 14h, and also the main rotation reflector 14e, The scan speed of interference

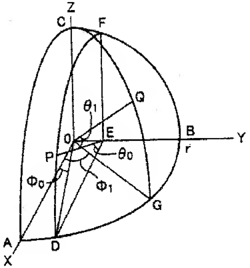
fringes is made equal to phase velocity, and consistency of the phase of interference fringes and an elastic-surfaces wave is performed. The laser beam L1 and L2 have the long pulse for about 100 ns designed specially, in order to attain the long interaction time between interference fringes and an elastic-surfaces wave.
[0070]The above-mentioned predetermined range W ((b) of drawing 7) has specified the ring field 12b continuous in a circle specified along the maximum circumference line 12a by a part of inner skin (inner surface) of the spherical substrate 10. Thus, the inside of the width of a certain ring can be made to go around by exciting so that the elastic-surfaces wave of a wavelength which had a certain sound source width and met on the spherical inner surface at conditions may be spread in the specific direction, even if it does not use a comb type electrode, without being spread.
[0071]Detection of an elastic wave which carries out excitation propagation can be optically carried out to an inside using the knife edge method etc. When using the knife edge method, the convergence irradiation of the laser beam extracted thinly is carried out to the minute field of the material list side in which the laser of an inside is reflected, and a part of the reflected light is covered to a slit etc. Conversion to signals of the intensity of the beam which was not covered can be electrically carried out using a photo-diode etc., and an elastic-surfaces wave can be observed as an electric signal by non-contact from the deflection of the laser reflective wave beam by the minute inclination on the inner surface which occurs because an elastic-surfaces wave spreads a substrate inside.
[0072]There is no necessity of forming a piezo-electric material for exciting an elastic-surfaces wave in this composition, In order for there to be also no electrode by which the patterning was carried out, it is clear it not only not to to check propagation of the elastic-surfaces wave which a piezo-electric material is excited and goes a substrate inside around, but to have the feature of being able to excite arbitrary frequency.
[0073]If the surface acoustic device of this invention is formed also by the embodiment described above in the middle of piping by which a fluid is conveyed as shown in drawing 4 (d), When there is nothing with the time of there being a fluid, it is clear that sound wave velocity's of an elastic-surfaces wave it can use as a fluid sensor using changing also with the elastic character of a fluid.
[0074]It is not necessary to form the elastic-surfaces wave generating means constituted from a method especially using laser with the piezo-electric body etc. by the fluid which flows through an inside for example, and has chemically an advantage which can also constitute the sensor of a reactant high fluid.
[0075]The elastic-surfaces wave which spreads the substrate inside of the inside shape of a ball to band-like can also constitute two or more elastic-surfaces wave generating means in the same inside from not influencing mutually, even if it crosses a propagation path mutually. This thing is also the same as when [also when exciting an elastic-surfaces wave using a piezo-electric material] exciting using a laser beam. The example is shown in drawing 8. In this case, two elastic-surfaces wave generating means are created so that the band-like circumference courses 60 and 61 of each generated elastic-surfaces wave may cross mutually. The circumference course for a reception consists of applying to the portion except the field of the circumference course 60 the material from which elastic character changes with gas. While the output by the circumference course of the circumference course 61 changes an output by change of the gas which flows through the inside of a substrate, it is influenced also by a temperature change, but it is possible to measure a temperature change from signal change of the circumference course 60, and to constitute the result of the circumference course 61.
[0076]

[Effect of the Invention][explained / in full detail / above] [like / it is ****** and] [the spherical surface acoustic device according to this invention] Compared with the conventional surface acoustic device, it is compact and it not only can improve performance far, but can constitute the sensor of a fluid or gas easily, Since a stable surface acoustic device can be constituted to external environment and the propagation field of the elastic-surfaces wave is formed in the inside of a substrate if an inside is sealed with a vacuum, specific gas, or a fluid, handling and fixation are easy and can also form an electronic circuit etc. in the surface of the substrate exterior.
[0077]The above-mentioned advantage is common, is processing on the surface of a substrate especially, and can also make it serve as an optical system also by the method of performing generating of an elastic-surfaces wave using a laser beam.

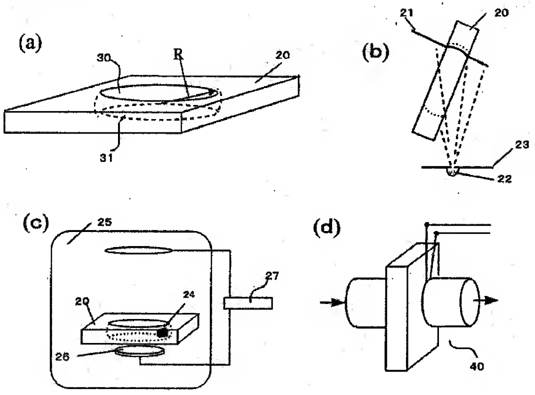
[Brief Description of the Drawings]
[Drawing 1]Explanatory view ****** the rough explanatory view of the spherical surface acoustic device to which drawing 1 (a) followed a 1st embodiment of this invention in the explanatory view showing the example of a 1st embodiment of the spherical surface acoustic device of this invention, and drawing 1 (b) indicated an example of the elastic-surfaces wave generating means to be at the plane.
[Drawing 2]It is a perspective view showing roughly the coordinate system used as the foundation of the formula used in order to specify the width which provides an oscillating means in the predetermined position on the surface of inner of a spherical surface acoustic device.
[Drawing 3][(a), (b), (c), and (d)] With the formula created using the coordinate system of drawing 2. The elastic-surfaces wave produced by changing the wave number parameter m (ratio of the length of the circumference to the wavelength of an elastic-surfaces wave) and opening half width (1/2 of width which establishes an oscillating means) which were calculated is a figure showing roughly four states which spread a substrate top with a spherical inside of a spherical surface acoustic device.
[Drawing 4]It is an explanatory view when the fluid sensor using the spherical surface acoustic device according to a 1st embodiment of drawing 1 is constituted.
[Drawing 5]The explanatory view in which (a) constituted the circuit using the fluid sensor of drawing 4, the figure showing the pulse shape which inputted (b) into the sensor, and (c) are the figures showing the waveform outputted from the sensor.
[Drawing 6]It is an explanatory view showing a part of embodiment of the surface-of-a-sphere surface acoustic device of this invention.
[Drawing 7]A laser oscillation device which has (a) for deriving an elastic-surfaces wave using the laser used with the form of the 2nd embodiment, and can be, The explanatory view of the optical system which performs the processing, and the method of the cartridge surface wave generated on the elastic-surfaces wave surface being, and detecting it with laser, and (b) are the explanatory views showing in a section the composition of the surface acoustic device which has for adopting the method of exciting an elastic-surfaces wave using laser, and is according to a 2nd embodiment.
[Drawing 8]It is an explanatory view showing a part of embodiment of the surface-of-a-sphere surface acoustic device of this invention.
[Explanations of letters or numerals]

1 .... Spherical surface acoustic device
2 .... Substrate
2a ... The maximum circumference line
2b ... Ring field
2c ... The spherical inner surface
4 .... Elastic-surfaces wave generating means
4a ... Piezo-electric material film
4b ... Oscillating means
4c ... Kushigata electrode (top electrode)
4d ... Kushigata electrode (lower electrode)
6 .... High frequency power supply
8 .... Base material
9 .... Substrate
10 .... Substrate
12 .... The surface in a substrate
12a ... The maximum circumference line
12b ... Ring field
20 .... Thick board
21 .... Vapor deposition mask
22 .... Deposition material
23 .... Vapor deposition heater
24 .... Lower electrode
25 .... Chamber
26 .... Target
27 .... DC high-pressure power supply
30 .... Opening
31 .... Opening
40 .... Fluid perception sensor
41 .... Circulator
42 .... Amplifier
43 .... Oscilloscope
44 .... Impulse signal generator
50 .... Substrate
51 .... The surface in a substrate
52 .... Surface elastic wave generating means
60 .... Circumference course for correction for temperature
61 .... Circumference course for a reception

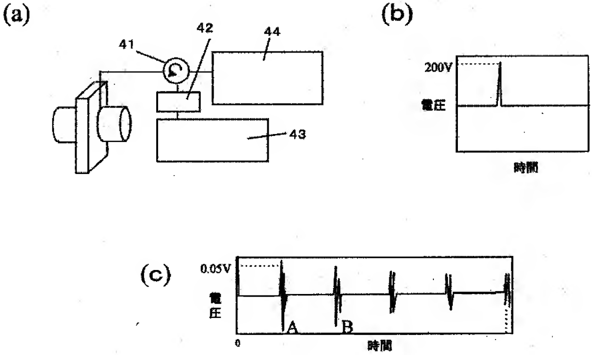
[Drawing 2]



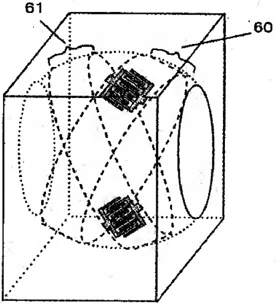
[Drawing 4]



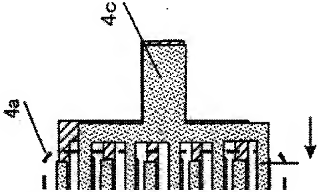
[Drawing 5]

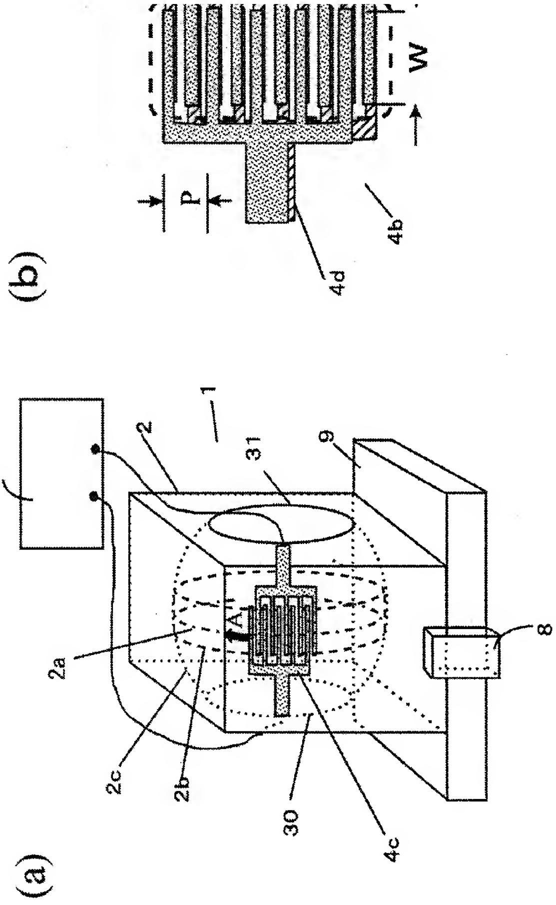


[Drawing 8]

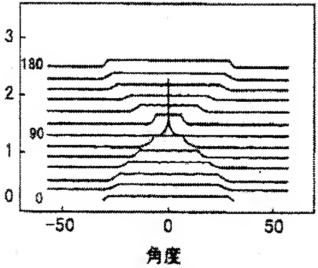


[Drawing 1]

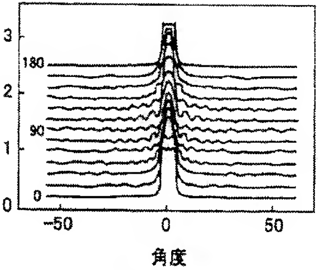




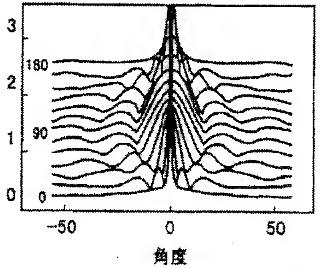
[Drawing 3]



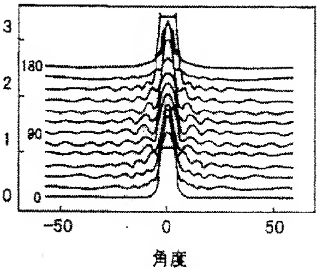
(A) m＝600、開口半角 θ_A ＝ 30deg



(B) m＝600、開口半角 θ_A ＝ 3.5deg

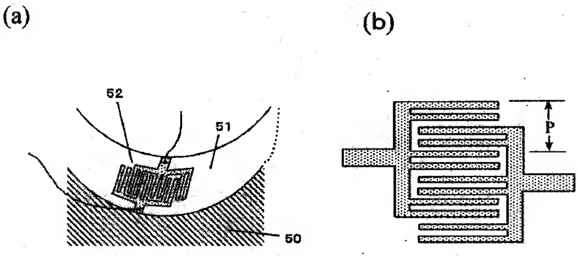


(C) m＝600 、開口半角 θ_A ＝ 1deg

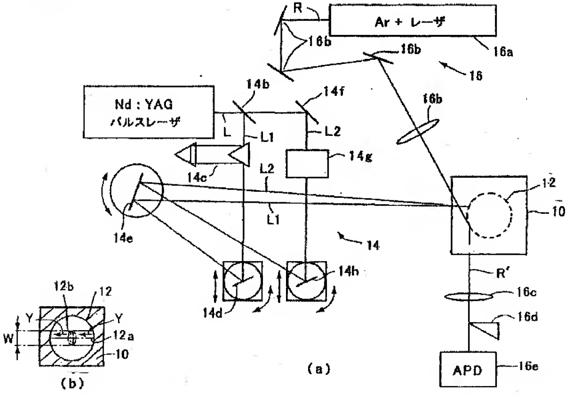


(D) m＝300、開口半角 θ_A＝ 4.5deg

[Drawing 6]


(a)
52
51
50
(b)
P

[Drawing 7]


R
Ar + レーザ
16b
16b
16a
16
14b
14f
16b
Nd : YAG
パルスレーザ
L
L1
L2
14g
14c
L2
12
L1
10
14e
14
14h
R'
12b
12
16c
Y
Y
W
12a
14d
16d
10
(b)
(a)
APD
16e

[Translation done.]